# SAMPLING AND ANALYSIS PLAN

## Platte Rotating Basin Probabilistic Survey

**North Platte, South Platte, and Niobrara Watersheds**

**Wyoming Dept. of Environmental Quality**
**Water Quality Division, Watershed Protection Program**

**March 2016**

# Contents

## BACKGROUND

Probabilistic rotating basin surveys (PRBS) address the primary objectives of the Wyoming Surface Water Quality Monitoring Strategy (WDEQ 2010). PRBS involve sampling a randomly selected subsample of a population of interest, similar to a census, in order to make inferences about characteristics of the population as a whole. Wyoming uses a customized generalized random tessellation-stratified (GRTS) survey design using the 1:100,000 scale National Hydrographic Dataset Plus (NHD+) as the base sample frame (see http://archive.epa.gov/nheerl/arm/web/html/presents.html; Stevens and Olson, 2004) from which 50 primary sites are randomly selected from a target population of perennial, non-headwater (>1$^{st}$ Strahler order) rivers and streams outside of national parks, congressionally-designated wilderness areas and the Wind River Reservation within each of five geographic divisions of the State. The geographic divisions are referred to in this document and WDEQ (2010) as 'superbasins' due to their delineation using combinations of 6-digit (3$^{rd}$ level) Hydrologic Unit Codes (HUC) and geographical location. The five superbasins and the associated HUC 6 basins they represent are:

Bighorn/Yellowstone [Bighorn and Yellowstone Basins] - PRBS completed in 2010
Northeast [Belle Fourche, Cheyenne, Little Missouri, Powder and Tongue Basins] - PRBS completed in 2011
Green [Great Divide, Green and Little Snake Basins] - PRBS completed in 2015
**Platte [Niobrara, North Platte and South Platte Basins] - PRBS scheduled for 2016**
Bear/Snake [Bear and Snake Basins] - PRBS scheduled for 2020

Site selection is further stratified into aggregations of 8-digit (4$^{th}$ level) HUCs, or "HUC 8 clusters," within each superbasin. The additional level of stratification helps achieve more equal spatial allocation of the 50 primary sites among all HUC 8 clusters and across a superbasin. Following the same design, a population of 100 oversample sites (also stratified by HUC 8 cluster) is generated for each superbasin to be used as replacements when a primary site cannot be sampled. Oversample sites are used as replacements for primary sites occurring within the same HUC 8 cluster to maintain representativeness and minimize logistical complexities of sampling. Data from the approximately 50 sites ultimately sampled within each superbasin are used to make statistical inferences about water quality conditions within each superbasin, including the proportion of the stream target population likely achieving water quality standards or statistically derived expected conditions, and the occurrence, extent and relative risk of various pollutants. Data from PRBS are not used to make determinations of designated use support or resultant categorization decisions in Wyoming's §305(b)/303(d) Integrated Report. PRBS data are used to identify waters of high quality and those where designated use-support may be limited, and thus are candidates for future targeted monitoring for determinations of designated use support. Stream sites are screened using a multi-factor prioritization strategy to determine if targeted monitoring will be conducted.

## CREDIBLE DATA

All data are collected with the intent to address the credible data law as described in Section 35 (a and b) of Chapter 1, Wyoming Water Quality Rules and Regulations, and Wyoming Environmental Quality Act § 35-11-302 (b)(i) and (b)(ii). Because PRBS data will not be used for making designated use support determinations, this sampling and analysis plan (SAP) may not achieve all current policy expectations for projects intended for that purpose.

## SAMPLING

### Monitoring Objectives

The objectives of the Platte PRBS are 1) objectively evaluate water quality conditions, including the proportion of target population stream miles likely achieving water quality standards or statistically derived expected conditions, and the occurrence, extent and relative risk of various pollutants, and 2) identify both

high quality and low quality waters that are candidates for future targeted monitoring for determinations of designated use support.

**Study Design**

The study design follows the GRTS approach described above. Specific details for the Platte PRBS include:

A) The Platte is divided up into six HUC8 clusters: Upper North Platte, Middle North Platte, Lower North Platte-South Platte-Niobrara, Sweetwater, Medicine Bow, and Laramie
B) 50 primary sites and 100 oversample sites are divided between the six HUC8 clusters
C) First order streams, and all streams within congressionally-designated wilderness areas are excluded from the survey
D) The following factors would lead to a survey site being considered non-target and an oversample site selected: beaver dam complexes, other impoundments or generally lotic environments that would encompass the entire extent of an assessment reach; ephemeral flow regime; a dry channel within a distance of twenty bankfull widths upstream or downstream of the x-site (dry reach of an otherwise perennial or intermittent stream); man-made ditches or canals (channelized natural streams are within survey objectives)

**Sampling Schedule and Frequency**

Each survey site determined to meet target population criteria and having legal access will be sampled once between July 1, 2016 and October 15, 2016.

**Monitoring Locations**

See Appendix A for a list and locations of all primary and oversample sites (x-sites). See Figure 1 for a generalized map of all primary and oversample sites.

**Standard Operating Procedures**

All standard operating procedures (SOPs) referenced within this SAP are found within the Manual of Standard Operating Procedures for Sample Collection and Analysis (WDEQ 2015).

**Sites Requiring Authorization to Access or Conduct Surveys**

For access to or across private lands, authorization will be sought according to the internal standard operating procedure (SOP) for *Private Land Access*. For surveys conducted on Wyoming State Trust lands, authorization to survey will be sought from the Office of State Lands and Investments (OSLI). Grazing lease holders will be notified as required by OSLI policy. Approved private property access only applies to designated WDEQ staff and does not extend to other personnel/parties who may wish to accompany WDEQ during surveys.

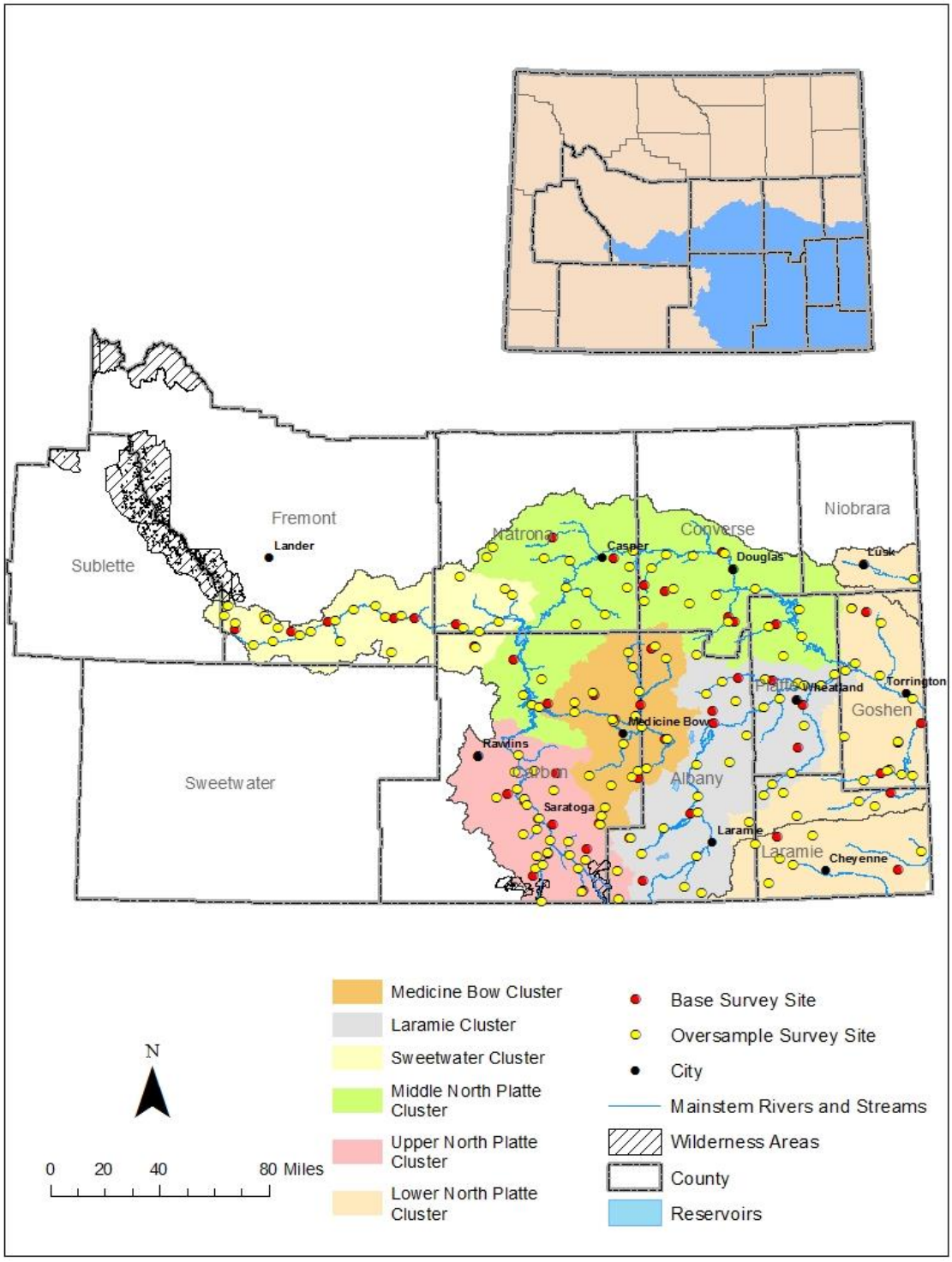
**Other Notifications**

Conservation Districts and federal land management agencies will be notified of intent to conduct surveys at sites within their jurisdiction and offered an opportunity to participate. This SAP and the 2016 monitoring workplan will be posted online at http://deq.wyoming.gov/wqd/surface-water-monitoring/resources/strategy-plan/.

**Personnel**

*Cheyenne field office staff:* Eric Hargett (307-777-6701) or Lanny Goyn (307-777-6353)
*Lander field office staff:* Tavis Eddy (307-335-6957) or Mike Wachtendonk (307-335-6751)
*Sheridan field office staff:* Jason Martineau (307-675-5632), Chad Rieger (307-675-5637), or Jeremy ZumBerge (307-675-5638)

**Figure 1. Platte Basin probabilistic rotating basin survey sites**



**Locating Survey Site and Establishing Evaluation Reach**

Samplers will follow the SOP for *Sample Location Determination for Probabilistic Surveys (Lotic).*

Following the establishment of the evaluation reach, sampling is conducted in general accordance with the SOP for *Monitoring Procedure Sequence (standard)*.

**Sampled Parameters and Methods**

| Parameter | Sampling Method / SOP | Reporting Units RU | Analytical Method / SOP | Preservative | Holding Time | Reporting Limit |
|---|---|---|---|---|---|---|
| **Chemical** | | | | | | |
| Alkalinity, Total (as $CaCO_3$) | Grab | mg/L | SM2320B | Iced | 14 days | 10 |
| Ammonia, as N | Grab | mg/L | SM4500-NH4D | 1:1 $H_2SO_4$; Iced | 28 days | 0.10 |
| Ca, Mg, K, Na (dissolved) | Grab | mg/L | E200.7/200.8 | 1:1 $HNO_3$, Iced | 6 months | 1.0 |
| Chlorides, Total | Grab | mg/L | E 300.0 | Iced | 28 days | 1.0 |
| Conductivity | DM | µS/cm | SM2510-B | None; DM | N/A | 0.10 |
| Se (total), As, Cd, Zn, Al, Fe, Mn, Cu, Ag, Pb, (dissolved) | Grab | µg/L | E200.7/200.8 | 1:1 $HNO_3$, Iced | 6 months | 1.0-50 |
| Dissolved Oxygen (DO) | DM | mg/L; % sat. | ASTM D 885-05 / A4500-O(G) /E360.1 | None; DM | N/A | 0.01 |
| Hardness, Total (as $CaCO_3$) | Grab | mg/L | SM2340 B | 1:1 $HNO_3$, Iced | 6 months | 1.00 |
| Nitrite-Nitrate, as N | Grab | mg/L | E353.2 | 1:1 $H_2SO_4$; Iced | 28 days | 0.05 |
| Nitrogen, Total | Grab | mg/L | SM4500-N B | 1:1 $H_2SO_4$; Iced | 28 days | 0.10 |
| pH | DM | S.U. | SM4500-$H^+$ | None; DM | N/A | 0.01 |
| Phosphorus, Total | Grab | mg/L | E365.3 | 1:1 $H_2SO_4$; Iced | 28 days | 0.10 |
| Sulfates, Total | Grab | mg/L | E300.0 | Iced | 28 days | 0.10 |
| Temperature, Water | DM | C° | SM2550 | None; DM | N/A | 0.01 |
| Total Suspended Solids | Grab | mg/L | SM2540D | Iced | 7 days | 1.0 |
| Turbidity | Grab | NTU | SM2130B | None; DM | N/A | 1 |
| Herbicides and Pesticides | Grab | µg/L | E507m, E515.1, E531.1, E547.0 | All: Iced E531.1: 1.2ml monochloroacetic acid | 14 days; 28 days for E531.1 | 1.0 - 10 |
| **Biological** | | | | | | |
| Chlorophyll α | See SOP for *Periphyton Sampling* | $mg/m^2$ | SM10200H | 10ml of 99% Ethyl Alcohol, iced; see SOP for *Periphyton Sampling* | 21 days | 0.10 |
| Macroinvertebrates | See SOPs for *Macroinvertebrate Sampling* | Raw counts & Density | SOP for *Macro-invertebrate Sample Identification* | 99% Ethyl Alcohol; see SOP for *Macro-invertebrate Sample Preservation* | Indefinite | |
| Periphyton | See SOP for *Periphyton Sampling* | Raw counts & Density | SOP for *Periphyton Sample Identification* | 5-10% Lugol's; see SOP for *Periphyton Sampling* | Indefinite | |
| E. coli bacteria | See SOP for Coliform Bacteria Sampling Procedure | CFU/100ml | See SOP for *Escherichia coli & Total Coliform Bacteria Colilert®-Defined Enzyme Substrate Method* | Iced | 8 hours | 1 CFU/100ml |

| **Physical** | | | | | | |
|---|---|---|---|---|---|---|
| Bank stability & cover | See SOP for *Monitoring Procedure Sequence (standard)* | N/A | N/A | N/A | N/A | N/A |
| Channel type, Rosgen | See SOP for *Rosgen Channel Type Classification* | N/A | N/A | N/A | N/A | N/A |
| Cross-sections, Riffle | See SOP for *Channel Cross-section – Survey Method* | N/A | N/A | N/A | N/A | N/A |
| Discharge | See SOP for *Stream Discharge* | cfs | See SOP for *Stream Discharge* | None; DM | N/A | 0.01 |
| Gradient, Riffle and Reachwide | See SOP for *Reachwide and Riffle Gradients – Survey Method* | N/A | See SOP for Reachwide and Riffle Gradients – Survey Method | N/A | N/A | N/A |
| Qualitative riparian vegetative structure and human influence survey | See SOP for *Monitoring Procedure Sequence (standard)* | N/A | N/A | N/A | N/A | N/A |
| Qualitative stream and riparian condition survey | See SOP for *Monitoring Procedure Sequence (standard)* | N/A | N/A | N/A | N/A | N/A |
| Qualitative reach and watershed characterization | See SOP for *Monitoring Procedure Sequence (standard)* | N/A | N/A | N/A | N/A | N/A |
| Substrate, Riffle | See SOP for *Macroinvertebrate Sampling* | mm | See SOP for *Macroinvertebrate Sampling* | N/A | N/A | 0.10 |
| Substrate, Reachwide | See SOP for *Pebble Counts, Reachwide and Cross-sections* | mm | See SOP for Pebble Counts, Reachwide and Cross-sections | N/A | N/A | 0.10 |

DM = Direct Measurement

## QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)

### Data Recording

All data and information collected in the field will be recorded on official Field Data Sheets (see SOP for *Monitoring Procedure Sequence (standard)*). Field notebooks maybe used in addition to Field Data Sheets in some cases. Samples sent for laboratory analysis will be recorded on official chain of custody forms (see SOP for *Chain of Custody*).

### Data Verification and Validation

See SOPs for *Data Validation* and *Data Verification* along with the Qa/Qc process flow chart (Appendix B).

**Field Quality Control (QC) for Chemical and Biological Samples**

| Field Qc Samples | Collection Frequency | Parameters |
|---|---|---|
| Trip Blank | One on the day of and prior to travel to the Platte Basin PRSB study area (typically one per week)(Chemical) | All listed, except DM |
| Field Blank | One for every 10 samples collected (Chemical) | All listed, except DM |
| Duplicate | One for every 10 samples collected (Chemical and Biological) | All listed |

See SOP for *Quality Control Measures, Summary of;* DM=Direct Measurement

**Electronic Equipment Calibration, Maintenance and Calibration Logs**

| Item | Calibration | Calibration Check | Maintenance | Calibration Log |
|---|---|---|---|---|
| pH meter – Hydrolab MS5 or Hanna 9023 or 9025C | Once daily pH 7 and 10 standards | Once daily at end of sampling event with pH 7 standard | Re-condition according to owner's manual. Remove precipitate/debris and keep probe bulb moist | See SOP for *Instrument Calibration and Calibration Logs* |
| Conductivity meter – Hydrolab MS5 or Hanna 9033 | Once daily using a standard appropriate to the setting | Once daily at end of sampling event using the calibration standard | Re-condition according to owner's manual. Remove precipitate/debris | See SOP for *Instrument Calibration and Calibration Logs* |
| D.O. meter – Hydrolab MS5 (optical) or YSI 95/10 or Orion 810A | Once daily or with each 200 ft change in elevation | None | Re-condition according to owner's manual. Remove precipitate/debris and keep probe bulb moist | See SOP for *Instrument Calibration and Calibration Logs* |
| Flow meter – Marsh-McBirney | Once annually | None | Remove precipitate/debris | See SOP for *Instrument Calibration and Calibration Logs* |

## LABORATORIES

The following laboratories will provide analytical services for samples collected as part of the project described in this SAP:

1. Wyoming Department of Environmental Quality, Water Quality Division Laboratory (WQD lab).
   The WQD lab will be the primary provider of analytical services for water samples collected as part of this project. The WQD lab will provide customized packages of bottles, labels, preservatives, and chain of custody forms prior to samples being collected as requested by samplers. Samplers will either hand deliver or ship samples to the WQD lab using United Parcel Service or Federal Express. The WQD lab will analyze samples in accordance with established standards for holding time, analytical method, and data quality assurance and control. Results of analyses typically will be returned to samplers within 30 days of receipt of samples by the WQD lab. The WQD lab will follow the Watershed Program standard operating procedures and QAPP (http://deq.wyoming.gov/wqd/qaqc/).

2. Energy Laboratories, Inc. (ELI)
   ELI has provided analytical services to the Watershed Program since 2006, and is under contract with the Watershed Program through 2016. ELI-Casper will analyze herbicides and pesticides and also may analyze split samples for select parameters. Samplers will either hand deliver or ship samples to ELI using United Parcel Service or Federal Express. ELI-Casper will analyze samples in accordance with industry standards for holding time, analytical method, and data

quality assurance and control, and will generally report results within 10 working days. The ELI-Casper Quality System including the quality assurance manual, qualifications manual, NELAP and other certifications, and performance evaluation certificates is available at: http://www.energylab.com/QualityControl.asp

3. Rhithron Associates (Rhithron)
   Rhithron will provide taxonomic identification services for macroinvertebrate and periphyton samples collected as part of this project. Rhithron has provided taxonomic services to the Watershed Program since 2004 and is under contract through June 30, 2018. Preserved macroinvertebrate and periphyton samples will be sent to Rhithron at the end of the field season. Rhithron will provide results to samplers within 90 days of receipt of samples. Rhithron will subsample, sort and identify specimens according to contract terms and the SOP for Macroinvertebrate Sample Identification. Established standards for taxonomic identification will be followed.

## DATA

### Data Management

| Data Type | Storage | Location |
|---|---|---|
| Chemical | SWM 2.0 database, Spreadsheet and .pdf | WDEQ Cheyenne, Lander, and Sheridan |
| Biological, Macroinvertebrate | SWM 2.0 database, Spreadsheet and .pdf | WDEQ Cheyenne, Lander, and Sheridan |
| Biological, Periphyton | Algal database, Spreadsheet and .pdf | WDEQ Cheyenne, Lander, and Sheridan |
| Physical, Survey | Rivermorph 4.3, SWM 2.0 database (summary only), Spreadsheet | WDEQ Cheyenne, Lander, and Sheridan |
| Physical, Other | SWM 2.0 database, Spreadsheet | WDEQ Cheyenne, Lander, and Sheridan |

### Data Archiving

| Data Item | Format | Backup Copy & Format | Location | Retention |
|---|---|---|---|---|
| Field Data Sheets | Paper | None | WDEQ Cheyenne, Lander, and Sheridan | Permanent |
| Photographs | Electronic (.jpg and .docx) & Paper | Electronic (.jpg and .docx) | WDEQ Cheyenne, Lander, and Sheridan | Permanent |
| Field Log Books | Paper | Paper | WDEQ Cheyenne, Lander, and Sheridan | Permanent |
| Laboratory Results/Qa | Electronic (.pdf) & Paper | Electronic (.pdf) & Paper | WDEQ Cheyenne, Lander, and Sheridan | Permanent |
| Agency Qa Reports | Electronic (.docx and .pdf) & Paper | Electronic (.docx and .pdf) & Paper | WDEQ Cheyenne, Lander, and Sheridan | Permanent |
| Calibration Logs | Paper | None | WDEQ Cheyenne, Lander, and Sheridan | Permanent |
| Chain of Custody Forms | Electronic (.xlsx) & Paper | Electronic (.xlsx) & Paper | WDEQ Cheyenne, Lander, and Sheridan | Permanent |
| Spreadsheets, other electronic files | Electronic (.xlsx, .rmp, .txt, .dbf) & Paper | Electronic (.xlsx, .rmp, .txt, .dbf) & Paper | WDEQ Cheyenne, Lander, and Sheridan | Permanent |
| Database | Electronic (.mdb, other) | Electronic (.mdb, other) | WDEQ Cheyenne, Lander, and Sheridan | Permanent |
| Reports, emails, letters | Electronic (.wpd, .pdf, .html) & Paper | Electronic (.docx, .pdf, .html) & Paper | WDEQ Cheyenne, Lander, and Sheridan | Permanent |

-All records are the property of the State and therefore subject to the Wyoming Public Records Act.
-Records may be transferred to the Wyoming State Archives according to procedures in the Wyoming Records Management Manual.

**Site-Specific Data Analysis**

Analytical methods for this study include but are not limited to the following:

| Data Type | Analytical Method | Analysis Description |
|---|---|---|
| Chemical, all | Wyoming Water Quality Standards (WDEQ 2013) or statistically-derived expected conditions for parameters without numeric standards | Compare to State acute and chronic numeric criteria or statistically-derived expected conditions |
| Biological, Macroinvertebrate and Periphyton | Wyoming Water Quality Standards (WDEQ 2013) | Compare to State narrative criteria protective of aquatic life using a weight-of-evidence approach. |
| Biological, Macroinvertebrate | WSII (Hargett 2011) and WY RIVPACS (Hargett 2012) | Biocriteria derived from the model output are used to evaluate attainment of Chapter 1, Section 32 with respect to the expected regional reference condition at each monitoring site. |
| Biological, Macroinvertebrate and Periphyton | Metrics | Selected macroinvertebrate metrics not associated with the WSII and several diatom metrics will be compared to regional reference expectations. |
| Biological, E. coli bacteria | Wyoming Water Quality Standards (WDEQ 2013) | Compare single sample to appropriate criterion in Section 27(a or b) |
| Physical, Other | WARSSS (Rosgen 2006) | Assess whether indicators of excess sedimentation or degradation are present at each site. |

## REPORT

Platte Basin data analysis methods and results will be reported in an overall project report to be completed approximately three years after completion of sampling. This report, in addition to reports for previous probabilistic surveys, will be posted online at http://deq.wyoming.gov/wqd/surface-water-monitoring/resources/publications/.

## REFERENCES

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WDEQ. 2016. Quality Assurance Project Plan (QAPP) for Water Quality Monitoring. Wyoming Department of Environmental Quality, Water Quality Division, Cheyenne, Wyoming. http://deq.wyoming.gov/wqd/qaqc/resources/qapp/

WDEQ. 2015. Manual of standard operating procedure for sample collection and analysis. Wyoming Department of Environmental Quality, Water Quality Division, Cheyenne, Wyoming. http://deq.wyoming.gov/wqd/qaqc/resources/manual/

WDEQ. 2013. Water Quality Rules and Regulations, Chapter 1, Wyoming Surface Water Quality Standards. Wyoming Department of Environmental Quality, Water Quality Division, Cheyenne, Wyoming. http://soswy.state.wy.us/Rules/RULES/9176.pdf

## **APPENDIX A.** Platte probabilistic rotating basin survey sites

| Survey ID | Stream Name | Type | Latitude | Longitude | HUC8 Cluster | Field Office |
|---|---|---|---|---|---|---|
| WY09C-151 | Fox Creek | Base | 41.11047465 | -106.07806993 | Laramie | Cheyenne |
| WY09C-152 | Nash Fork | Base | 41.33910435 | -106.16901799 | Laramie | Cheyenne |
| WY09C-153 | Richeau Creek | Base | 41.80001592 | -104.96583519 | Laramie | Cheyenne |
| WY09C-154 | North Laramie River | Base | 42.17860928 | -105.37706562 | Laramie | Cheyenne |
| WY09C-155 | | Base | 42.15878462 | -105.13436314 | Laramie | Cheyenne |
| WY09C-156 | Duck Creek | Base | 42.00696918 | -105.56636047 | Laramie | Cheyenne |
| WY09C-157 | Little Laramie River | Base | 41.46219899 | -105.73370493 | Laramie | Cheyenne |
| WY09C-158 | Chugwater Creek | Base | 42.02367824 | -104.92258182 | Laramie | Cheyenne |
| WY09C-159 | Laramie River | Base | 41.93798965 | -105.55701856 | Laramie | Cheyenne |
| WY09C-501 | North Fork Little Laramie River | Oversample | 41.33980791 | -106.15978893 | Laramie | Cheyenne |
| WY09C-502 | North Sybille Creek | Oversample | 41.72996279 | -105.45512457 | Laramie | Cheyenne |
| WY09C-503 | Laramie River | Oversample | 42.19750898 | -104.60668165 | Laramie | Cheyenne |
| WY09C-504 | | Oversample | 42.16654628 | -105.18794250 | Laramie | Cheyenne |
| WY09C-505 | Little Laramie River | Oversample | 41.25346108 | -106.08508232 | Laramie | Cheyenne |
| WY09C-506 | Sand Creek | Oversample | 41.54849420 | -105.21245134 | Laramie | Cheyenne |
| WY09C-507 | Sybille Creek | Oversample | 42.06142113 | -105.08397307 | Laramie | Cheyenne |
| WY09C-508 | North Laramie River | Oversample | 42.15942357 | -105.48835762 | Laramie | Cheyenne |
| WY09C-509 | Laramie River | Oversample | 41.23754440 | -105.69984808 | Laramie | Cheyenne |
| WY09C-510 | Laramie River | Oversample | 41.72296998 | -105.68461373 | Laramie | Cheyenne |
| WY09C-511 | North Laramie River | Oversample | 42.14045320 | -104.94914822 | Laramie | Cheyenne |
| WY09C-512 | Halleck Creek | Oversample | 41.87059642 | -105.32860178 | Laramie | Cheyenne |
| WY09C-513 | | Oversample | 41.07352379 | -105.79211711 | Laramie | Cheyenne |
| WY09C-514 | Laramie River | Oversample | 41.55209560 | -105.68513821 | Laramie | Cheyenne |
| WY09C-515 | Laramie River | Oversample | 42.12462130 | -104.78700201 | Laramie | Cheyenne |
| WY09C-516 | Laramie River | Oversample | 42.01582344 | -105.19889980 | Laramie | Cheyenne |
| WY09C-517 | Threemile Creek | Oversample | 41.61076624 | -105.15109968 | Laramie | Cheyenne |
| WY09C-518 | Chugwater Creek | Oversample | 41.66056393 | -105.01153629 | Laramie | Cheyenne |
| WY09C-519 | North Laramie River | Oversample | 42.30405501 | -105.66671360 | Laramie | Cheyenne |
| WY09C-520 | Laramie River | Oversample | 42.13070135 | -104.91121149 | Laramie | Cheyenne |
| WY09C-521 | McFarlane Creek | Oversample | 42.05654227 | -105.39855660 | Laramie | Cheyenne |
| WY09C-522 | Laramie River | Oversample | 41.46841760 | -105.68283637 | Laramie | Cheyenne |

| | | | | | | |
|---|---|---|---|---|---|---|
| WY09C-523 | | Oversample | 41.91559136 | -104.91512779 | Laramie | Cheyenne |
| WY09C-524 | Mill Creek | Oversample | 41.38694627 | -105.92519724 | Laramie | Cheyenne |
| WY09C-525 | Lone Tree Creek | Oversample | 41.04119193 | -105.67078549 | Laramie | Cheyenne |
| WY09C-526 | Laramie River | Oversample | 42.18020881 | -104.68344649 | Laramie | Cheyenne |
| WY09C-527 | Antelope Creek | Oversample | 42.09877247 | -105.60367393 | Laramie | Cheyenne |
| WY09C-160 | Lodgepole Creek | Base | 41.33212748 | -105.12570463 | Lower Platte | Cheyenne |
| WY09C-161 | Horse Creek | Base | 41.54033978 | -104.31851985 | Lower Platte | Cheyenne |
| WY09C-162 | Horse Creek | Base | 41.80792451 | -104.25581830 | Lower Platte | Cheyenne |
| WY09C-163 | Muskrat Creek | Base | 42.52887549 | -104.54918770 | Lower Platte | Cheyenne |
| WY09C-164 | Muddy Creek | Base | 41.13554019 | -104.28641904 | Lower Platte | Cheyenne |
| WY09C-165 | Rawhide Creek | Base | 42.50626884 | -104.44305504 | Lower Platte | Cheyenne |
| WY09C-166 | Bear Creek | Base | 41.64948090 | -104.38266363 | Lower Platte | Cheyenne |
| WY09C-167 | Horse Creek | Base | 41.90264525 | -104.08511660 | Lower Platte | Cheyenne |
| WY09C-528 | Horse Creek | Oversample | 41.50494711 | -104.54191542 | Lower Platte | Cheyenne |
| WY09C-529 | Horse Creek | Oversample | 41.62570466 | -104.15557602 | Lower Platte | Cheyenne |
| WY09C-530 | Horse Creek | Oversample | 41.40984626 | -105.32283556 | Lower Platte | Cheyenne |
| WY09C-531 | North Platte River | Oversample | 42.03298403 | -104.14014009 | Lower Platte | Cheyenne |
| WY09C-532 | North Bear Creek | Oversample | 41.56099210 | -105.07480801 | Lower Platte | Cheyenne |
| WY09C-533 | Little Horse Creek | Oversample | 41.47592791 | -104.43393786 | Lower Platte | Cheyenne |
| WY09C-534 | Middle Lodgepole Creek | Oversample | 41.29104135 | -105.28625156 | Lower Platte | Cheyenne |
| WY09C-535 | Horse Creek | Oversample | 41.81122926 | -104.25050060 | Lower Platte | Cheyenne |
| WY09C-536 | Lodgepole Creek | Oversample | 41.32861087 | -104.88214763 | Lower Platte | Cheyenne |
| WY09C-537 | Fox Creek | Oversample | 41.66565206 | -104.32333645 | Lower Platte | Cheyenne |
| WY09C-538 | Lone Tree Creek | Oversample | 41.08630545 | -105.19731510 | Lower Platte | Cheyenne |
| WY09C-539 | Niobrara River | Oversample | 42.67025519 | -104.09599464 | Lower Platte | Cheyenne |
| WY09C-540 | Horse Creek | Oversample | 41.43411424 | -104.98937565 | Lower Platte | Cheyenne |
| WY09C-541 | Bear Creek | Oversample | 41.63957791 | -104.23222390 | Lower Platte | Cheyenne |
| WY09C-542 | | Oversample | 42.23454901 | -104.53493705 | Lower Platte | Cheyenne |
| WY09C-543 | Rawhide Creek | Oversample | 42.44116987 | -104.34305908 | Lower Platte | Cheyenne |
| WY09C-544 | Spring Run | Oversample | 41.61296379 | -104.50218322 | Lower Platte | Cheyenne |
| WY09C-545 | Bear Creek | Oversample | 41.65779922 | -104.34285355 | Lower Platte | Cheyenne |
| WY09C-546 | North Fork Crow Creek | Oversample | 41.21040606 | -105.11652378 | Lower Platte | Cheyenne |
| WY09C-547 | Box Elder Creek | Oversample | 41.85191290 | -104.63372052 | Lower Platte | Cheyenne |
| WY09C-548 | Chivington Draw | Oversample | 41.22810619 | -104.11850797 | Lower Platte | Cheyenne |

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|---|---|---|---|---|---|---|
| WY09C-549 | | Oversample | 41.17544246 | -105.02078944 | Lower Platte | Cheyenne |
| WY09C-550 | | Oversample | 42.16584437 | -104.36993021 | Lower Platte | Cheyenne |
| WY09C-551 | Muskrat Creek | Oversample | 42.53028855 | -104.54837901 | Lower Platte | Cheyenne |
| WY09C-168 | Little Medicine Bow River | Base | 41.96681914 | -106.25823515 | Medicine Bow | Lander |
| WY09C-169 | Austin Creek | Base | 42.05796730 | -106.73363396 | Medicine Bow | Lander |
| WY09C-170 | Threemile Creek | Base | 41.65329583 | -106.09808064 | Medicine Bow | Lander |
| WY09C-171 | | Base | 42.34193783 | -105.98599892 | Medicine Bow | Lander |
| WY09C-172 | Difficulty Creek | Base | 42.09775800 | -106.40145674 | Medicine Bow | Lander |
| WY09C-173 | Turpin Creek | Base | 41.42235137 | -106.38167131 | Medicine Bow | Lander |
| WY09C-174 | Rock Creek | Base | 41.86346051 | -105.90635992 | Medicine Bow | Lander |
| WY09C-175 | Little Medicine Bow River | Base | 42.04617606 | -106.07547515 | Medicine Bow | Lander |
| WY09C-552 | | Oversample | 42.05420156 | -106.84862243 | Medicine Bow | Lander |
| WY09C-553 | Little Medicine Bow River | Oversample | 42.11581146 | -106.08682806 | Medicine Bow | Lander |
| WY09C-554 | Watkins Creek | Oversample | 41.66154797 | -106.14365882 | Medicine Bow | Lander |
| WY09C-555 | Medicine Bow River | Oversample | 41.46130924 | -106.36233413 | Medicine Bow | Lander |
| WY09C-556 | | Oversample | 42.04145922 | -106.79996710 | Medicine Bow | Lander |
| WY09C-557 | Little Medicine Bow River | Oversample | 42.24711903 | -106.11968751 | Medicine Bow | Lander |
| WY09C-558 | | Oversample | 41.69837305 | -106.10136832 | Medicine Bow | Lander |
| WY09C-559 | Wagonhound Creek | Oversample | 41.62093025 | -106.29521026 | Medicine Bow | Lander |
| WY09C-560 | | Oversample | 42.28763258 | -105.88436186 | Medicine Bow | Lander |
| WY09C-561 | Troublesome Creek | Oversample | 42.06062734 | -106.54174026 | Medicine Bow | Lander |
| WY09C-562 | | Oversample | 41.92822449 | -106.06875082 | Medicine Bow | Lander |
| WY09C-563 | Mill Creek | Oversample | 41.67429765 | -106.44676697 | Medicine Bow | Lander |
| WY09C-564 | Little Medicine Bow River | Oversample | 42.32516841 | -106.15405074 | Medicine Bow | Lander |
| WY09C-565 | Difficulty Creek | Oversample | 42.11212733 | -106.41398638 | Medicine Bow | Lander |
| WY09C-566 | Little Medicine Bow River | Oversample | 41.98763109 | -106.11498576 | Medicine Bow | Lander |
| WY09C-567 | Little Medicine Bow River | Oversample | 41.95822332 | -106.26686790 | Medicine Bow | Lander |
| WY09C-568 | Turpin Creek | Oversample | 41.41487680 | -106.37376088 | Medicine Bow | Lander |
| WY09C-569 | Medicine Bow River | Oversample | 42.00868696 | -106.54189517 | Medicine Bow | Lander |
| WY09C-570 | Medicine Bow River | Oversample | 41.83766913 | -106.20188879 | Medicine Bow | Lander |
| WY09C-571 | East Fork Medicine Bow River | Oversample | 41.50591705 | -106.33755598 | Medicine Bow | Lander |
| WY09C-572 | Threemile Creek | Oversample | 42.35623534 | -105.96606430 | Medicine Bow | Lander |
| WY09C-573 | Threemile Creek | Oversample | 41.70950068 | -106.03805100 | Medicine Bow | Lander |
| WY09C-574 | Merna (historical) | Oversample | 41.85955825 | -105.88798966 | Medicine Bow | Lander |

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|---|---|---|---|---|---|---|
| WY09C-575 | Little Medicine Bow River | Oversample | 41.96915094 | -106.27633715 | Medicine Bow | Lander |
| WY09C-176 | East Fork Elkhorn Creek | Base | 42.82580943 | -106.25169227 | Middle North Platte | Sheridan |
| WY09C-177 | Deweese Creek | Base | 42.29183002 | -106.98107500 | Middle North Platte | Sheridan |
| WY09C-178 | Mill Creek | Base | 42.50121694 | -105.43064609 | Middle North Platte | Sheridan |
| WY09C-179 | Virden Creek | Base | 42.64432450 | -105.88676606 | Middle North Platte | Sheridan |
| WY09C-180 | Mill Creek | Base | 42.47372311 | -105.39317696 | Middle North Platte | Sheridan |
| WY09C-181 | Horseshoe Creek | Base | 42.45560419 | -105.09283919 | Middle North Platte | Sheridan |
| WY09C-182 | South Fork Casper Creek | Base | 42.93890470 | -106.69380206 | Middle North Platte | Sheridan |
| WY09C-183 | Deer Creek | Base | 42.68016275 | -106.03726590 | Middle North Platte | Sheridan |
| WY09C-184 | North Platte River | Base | 42.84814088 | -105.46353054 | Middle North Platte | Sheridan |
| WY09C-576 | Middle Fork Casper Creek | Oversample | 42.89124218 | -107.12134119 | Middle North Platte | Sheridan |
| WY09C-577 | Deer Creek | Oversample | 42.83598682 | -105.87503984 | Middle North Platte | Sheridan |
| WY09C-578 | North Platte River | Oversample | 42.86028347 | -106.10987796 | Middle North Platte | Sheridan |
| WY09C-579 | North Platte River | Oversample | 42.84051107 | -105.44562409 | Middle North Platte | Sheridan |
| WY09C-580 | Poison Spider Creek | Oversample | 42.81396486 | -106.56741987 | Middle North Platte | Sheridan |
| WY09C-581 | Deer Creek | Oversample | 42.76890100 | -105.98038178 | Middle North Platte | Sheridan |
| WY09C-582 | North Platte River | Oversample | 42.64744530 | -105.23240801 | Middle North Platte | Sheridan |
| WY09C-583 | Cottonwood Creek | Oversample | 42.53159605 | -104.92509413 | Middle North Platte | Sheridan |
| WY09C-584 | Bates Creek | Oversample | 42.67252257 | -106.59775594 | Middle North Platte | Sheridan |
| WY09C-585 | Bates Creek | Oversample | 42.52988308 | -106.32041309 | Middle North Platte | Sheridan |
| WY09C-586 | Prele Creek, La | Oversample | 42.57940892 | -105.71086768 | Middle North Platte | Sheridan |
| WY09C-587 | Cottonwood Creek | Oversample | 42.28913397 | -105.04498314 | Middle North Platte | Sheridan |
| WY09C-588 | Bolton Creek | Oversample | 42.47433717 | -106.53022271 | Middle North Platte | Sheridan |
| WY09C-589 | Smith Creek | Oversample | 42.66493839 | -106.15517433 | Middle North Platte | Sheridan |
| WY09C-590 | Indian Creek | Oversample | 42.47455846 | -105.43992181 | Middle North Platte | Sheridan |
| WY09C-591 | Hurt Creek | Oversample | 42.10726897 | -106.90528777 | Middle North Platte | Sheridan |
| WY09C-592 | Box Elder Creek | Oversample | 42.65802989 | -105.82545059 | Middle North Platte | Sheridan |
| WY09C-593 | Poison Spider Creek | Oversample | 42.82891844 | -106.75542237 | Middle North Platte | Sheridan |
| WY09C-594 | North Platte River | Oversample | 42.38692815 | -104.91438023 | Middle North Platte | Sheridan |
| WY09C-595 | Wagon Hound Creek | Oversample | 42.62205946 | -105.51581726 | Middle North Platte | Sheridan |
| WY09C-596 | Lost Creek | Oversample | 42.18504170 | -106.77725236 | Middle North Platte | Sheridan |
| WY09C-597 | Clear Fork Muddy Creek | Oversample | 42.77540710 | -106.13487789 | Middle North Platte | Sheridan |
| WY09C-598 | Horseshoe Creek | Oversample | 42.44099176 | -105.15125036 | Middle North Platte | Sheridan |
| WY09C-599 | Deer Creek | Oversample | 42.59596758 | -106.03381837 | Middle North Platte | Sheridan |

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|---|---|---|---|---|---|---|
| WY09C-600 | Bates Creek | Oversample | 42.64627655 | -106.44977671 | Middle North Platte | Sheridan |
| WY09C-601 | Box Elder Creek | Oversample | 42.82686878 | -105.67828639 | Middle North Platte | Sheridan |
| WY09C-602 | Middle Fork Casper Creek | Oversample | 42.83415224 | -107.16746521 | Middle North Platte | Sheridan |
| WY09C-193 | Pete Creek | Base | 42.36258710 | -107.25229161 | Sweetwater | Lander |
| WY09C-194 | East Sweetwater River | Base | 42.44487819 | -108.97361477 | Sweetwater | Lander |
| WY09C-195 | Sweetwater River | Base | 42.51586116 | -107.83208857 | Sweetwater | Lander |
| WY09C-196 | Strawberry Creek | Base | 42.43959273 | -108.57126094 | Sweetwater | Lander |
| WY09C-197 | Rock Creek | Base | 42.50273411 | -108.75068040 | Sweetwater | Lander |
| WY09C-198 | Sweetwater River | Base | 42.48429112 | -107.38588722 | Sweetwater | Lander |
| WY09C-199 | Crooks Creek | Base | 42.51628292 | -107.68079368 | Sweetwater | Lander |
| WY09C-200 | Sweetwater River | Base | 42.49098300 | -108.30456289 | Sweetwater | Lander |
| WY09C-627 | Sweetwater River | Oversample | 42.41642133 | -108.50190301 | Sweetwater | Lander |
| WY09C-628 | Sweetwater River | Oversample | 42.51738433 | -107.89282706 | Sweetwater | Lander |
| WY09C-629 | Sweetwater River | Oversample | 42.44347087 | -107.21863608 | Sweetwater | Lander |
| WY09C-630 | Blair Creek | Oversample | 42.56798921 | -109.02499614 | Sweetwater | Lander |
| WY09C-631 | Sweetwater River | Oversample | 42.43848212 | -108.42538202 | Sweetwater | Lander |
| WY09C-632 | Sweetwater River | Oversample | 42.52493524 | -107.78472519 | Sweetwater | Lander |
| WY09C-633 | Horse Creek | Oversample | 42.63560866 | -106.98687134 | Sweetwater | Lander |
| WY09C-634 | Sweetwater River | Oversample | 42.51908479 | -109.04988532 | Sweetwater | Lander |
| WY09C-635 | East Alkali Creek | Oversample | 42.38894670 | -108.22009793 | Sweetwater | Lander |
| WY09C-636 | Sweetwater River | Oversample | 42.45892398 | -107.33371483 | Sweetwater | Lander |
| WY09C-637 | Crooks Creek | Oversample | 42.33029334 | -107.84989600 | Sweetwater | Lander |
| WY09C-638 | Sweetwater River | Oversample | 42.38390248 | -108.69565873 | Sweetwater | Lander |
| WY09C-639 | Sweetwater River | Oversample | 42.58063962 | -107.96630216 | Sweetwater | Lander |
| WY09C-640 | Horse Creek | Oversample | 42.66748952 | -107.03414345 | Sweetwater | Lander |
| WY09C-641 | Rock Creek | Oversample | 42.52229513 | -108.76316512 | Sweetwater | Lander |
| WY09C-642 | Rock Creek | Oversample | 42.45616701 | -108.65975891 | Sweetwater | Lander |
| WY09C-643 | Sweetwater River | Oversample | 42.49795572 | -108.25565653 | Sweetwater | Lander |
| WY09C-644 | Dry Creek | Oversample | 42.73662585 | -107.35806143 | Sweetwater | Lander |
| WY09C-645 | Pete Creek | Oversample | 42.35868397 | -107.24848247 | Sweetwater | Lander |
| WY09C-646 | Rock Creek | Oversample | 42.50068092 | -108.74699622 | Sweetwater | Lander |
| WY09C-647 | Sweetwater River | Oversample | 42.55924645 | -108.12424555 | Sweetwater | Lander |
| WY09C-648 | Sweetwater River | Oversample | 42.49595138 | -107.07827471 | Sweetwater | Lander |
| WY09C-649 | East Sweetwater River | Oversample | 42.47566283 | -108.97455251 | Sweetwater | Lander |

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| WY09C-650 | Sweetwater River | Oversample | 42.36604386 | -108.83514334 | Sweetwater | Lander |
| WY09C-185 | North Fork Miner Creek | Base | 41.14457360 | -106.84786894 | Upper North Platte | Cheyenne or Lander |
| WY09C-186 | | Base | 41.41472443 | -106.71037222 | Upper North Platte | Cheyenne or Lander |
| WY09C-187 | | Base | 41.53812348 | -106.90400889 | Upper North Platte | Cheyenne or Lander |
| WY09C-188 | | Base | 41.28428205 | -106.46990536 | Upper North Platte | Cheyenne or Lander |
| WY09C-189 | Encampment River | Base | 41.25949071 | -106.74595873 | Upper North Platte | Cheyenne or Lander |
| WY09C-190 | Rattlesnake Creek | Base | 41.68590224 | -106.67593588 | Upper North Platte | Cheyenne or Lander |
| WY09C-191 | Sage Creek | Base | 41.57733112 | -107.02803884 | Upper North Platte | Cheyenne or Lander |
| WY09C-192 | Big Creek | Base | 41.06535639 | -106.50214202 | Upper North Platte | Cheyenne or Lander |
| WY09C-603 | East Fork Encampment River | Oversample | 41.00868534 | -106.78700919 | Upper North Platte | Cheyenne or Lander |
| WY09C-604 | | Oversample | 41.69415880 | -106.97479014 | Upper North Platte | Cheyenne or Lander |
| WY09C-605 | | Oversample | 41.44700612 | -106.80078396 | Upper North Platte | Cheyenne or Lander |
| WY09C-606 | Brush Creek | Oversample | 41.32729152 | -106.60023348 | Upper North Platte | Cheyenne or Lander |
| WY09C-607 | Big Creek | Oversample | 41.05967546 | -106.50978769 | Upper North Platte | Cheyenne or Lander |
| WY09C-608 | Sage Creek | Oversample | 41.55834835 | -107.10546117 | Upper North Platte | Cheyenne or Lander |
| WY09C-609 | Pass Creek | Oversample | 41.59614213 | -106.70166727 | Upper North Platte | Cheyenne or Lander |
| WY09C-610 | North Platte River | Oversample | 41.25571489 | -106.58732855 | Upper North Platte | Cheyenne or Lander |
| WY09C-611 | Pass Creek | Oversample | 41.70387124 | -106.83463241 | Upper North Platte | Cheyenne or Lander |
| WY09C-612 | North Platte River | Oversample | 41.55157165 | -106.90459778 | Upper North Platte | Cheyenne or Lander |
| WY09C-613 | Cow Creek | Oversample | 41.25058101 | -106.82626736 | Upper North Platte | Cheyenne or Lander |
| WY09C-614 | Encampment River | Oversample | 41.26668709 | -106.74103400 | Upper North Platte | Cheyenne or Lander |
| WY09C-615 | North Platte River | Oversample | 41.78434512 | -106.94893777 | Upper North Platte | Cheyenne or Lander |
| WY09C-616 | North Spring Creek | Oversample | 41.36656411 | -106.91844266 | Upper North Platte | Cheyenne or Lander |
| WY09C-617 | French Creek | Oversample | 41.22582679 | -106.48324973 | Upper North Platte | Cheyenne or Lander |
| WY09C-618 | | Oversample | 41.33121044 | -106.72491692 | Upper North Platte | Cheyenne or Lander |
| WY09C-619 | Pelton Creek | Oversample | 41.01398389 | -106.25127916 | Upper North Platte | Cheyenne or Lander |
| WY09C-620 | | Oversample | 41.52086621 | -106.89219013 | Upper North Platte | Cheyenne or Lander |
| WY09C-621 | North Fork Encampment River | Oversample | 41.18484308 | -106.83477193 | Upper North Platte | Cheyenne or Lander |
| WY09C-622 | | Oversample | 41.20591842 | -106.77637415 | Upper North Platte | Cheyenne or Lander |
| WY09C-623 | North Platte River | Oversample | 41.60513062 | -106.95993846 | Upper North Platte | Cheyenne or Lander |
| WY09C-624 | South Spring Creek | Oversample | 41.39010979 | -106.82204663 | Upper North Platte | Cheyenne or Lander |
| WY09C-625 | North Platte River | Oversample | 41.17890566 | -106.52912448 | Upper North Platte | Cheyenne or Lander |
| WY09C-626 | Douglas Creek | Oversample | 41.16304981 | -106.25706116 | Upper North Platte | Cheyenne or Lander |

**APPENDIX B – Flow chart for Qa/Qc process.**